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ON THE OCCURENCE OF A COSTAL VEIN IN THE GENUS ARCHONIAS HBN. (LEPIDOPTERA: PIERIDAE).

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In the course of a series of dissections of various species of Pieridae, the author noticed what appeared to be a costal vein in the forewing of a specimen of *Archonias bellona* Cramer. Further examination showed that there was indeed a costal vein present here, and this prompted a scrutiny of a considerable body of material in this genus and others allied to it, the results of which are given in tabular form below.

Species	No. of specimens	Costal vein
Archonias bellona Cramer (various races)	24 ♂ ♂	present
	4 ♀ ♀	absent
Archonias tereas Godart (various races)	47 ♂ ♂	present
	11 ♀ ♀	absent
Archonias pharnakia Fruhstorfer	2 ♂ ♂	present
	1 ♀	absent
Charonias eurytele Hewitson (various races)	30 ♂ ♂	trace
	5 ♀ ♀	absent
Charonias theano Boisduval	2 ♂ ♂	trace
Catasticta (81 species)	ca. 400	absent*
Neophasia menapia Felder	21 ♂ ♂	absent
Eucheira socialis Westwood	1 ♀	absent

The above material was for the most part given an external examination under 30 diam. magnification. In addition, forewings of several specimens each from the genera *Archonias, Charonias, Catasticta* and *Neophasia* were divested of scales, cross-sectioned, and examined minutely in water.

From this date it appears:

(1) there is a well-developed costal vein present in the forewing of males throughout the genus *Archonias* (Figs. 1, C and 3, C). So far as the author is aware, the presence of this vein has not hitherto been recorded for any member of the Papilionoidea. Many writers make no mention of a costal vein in describing butterfly venation, and other (e.g. Scudder: Butterflies of the Eastern United States and Canada, Vol. 1, p. 40) give statements to the effect that "in butterflies, the foremost vein is always absent...."

(2) the costal vein, when present in the above genera, is confined to the males. In practise it was found quite a simple matter to separate the males of *Archonias* from the females by the use of this character, the determinations thus made being subsequently verified by a scrutiny of the genitalia. In males of

*Of these the author examined 92 specimens personally; the rest were examined by Mr. F. M. Brown, who noted a trace of the costal vein in three or four specimens. In no case, however, did this vein in *Catasticta* approach the degree of prominence which is apparently normal for males of *Archonias*.

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Charonias, this vein is present in an extremely reduced condition. The lumen of the vein cavity, which in *Archonias* has a diameter comparable with and even surpassing that of the subcosta, attains only about 1/20 of this diameter in *Charonias*. (fig. 2, C?) The vein in *Charonias* is so slight that the photograph has failed to show it at all clearly. In males of the genus *Archonias* the costal vein appears to be obsolete in its basal 5th or 6th. Dissection of this portion of the wing, however, has shown that there is here a trachea present which follows the costal margin of the wing and continues into the vein cavity where the latter becomes visible. The vein continues along the margin and around the apex to a point beyond R_3 but apparently not so far as R_{4+5}. The tips of the subcosta and of the first three branches of radius coalesce with the costal vein.

(3) the species *pharnakia* Fruhstorfer, which has been referred to the genus *Catasticta* by some authors, is without doubt an *Archonias*.

(4) *Charonias*, by virtue of the relatively great reduction of this vein, is shown to be less primitive than *Archonias*, and should doubtless stand as a distinct genus, though there can be no doubt that the two are closely allied (cf. Klots: Amer. Ent. XII (new series) p. 200-1933).

The author has not had the opportunity of examining a male of *Eucheira socialis* Westwood. Unless, or until, such a vein is found to be present in *Eucheira*, *Archonias* must be regarded as in at least one respect the most primitive of the group of genera with which it is commonly associated.

Examination has been made of some 25 other genera of Pieridae without revealing any trace of this vein beyond a slight deposition of pigmented material along the costal margin. Among those which it has unfortunately been impossible to include in this survey are *Eronia*, *Colotis*, and a number of allied genera. The author feels that an examination of these genera, with a view to determining the presence or absence of a costal vein, would be greatly desirable.

It does not seem necessary to burden a paper of this sort with an extensive bibliography. The author has endeavored to consult the pertinent literature, to which he herewith makes acknowledgement. The Generic Revision of Dr. A. B. Klots (op. cit.) has been of particular assistance. The nomenclature of the wing veins followed is that of Comstock and Needham.

TWO NEW SPECIES OF NOTOXUS (COLEOPTERA: ANTHICIDAE.)

BY FRANK E. BLAISDELL, SR.,
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Notoxus visaliensis n. sp.

Form elongate, moderately slender, sides of body parallel, three times as long as wide. Color usually nigro-piceous, at times more or less rufo-piceous; prothorax varying from rufo-testaceous to rufo-piceous; palpi, antennae and legs rufo-testaceous, at times clouded with fuscus. Luster more or less shining throughout. In paler specimens a rather broad, black transverse fascia is more or less distinct just behind the middle third of the elytra, this extends along the suture to base, gradually widening in basal third to involve the inner one-half of each elytron and scutellum; when the elytra are more or less rufotestaceous the apical area remains piceous and when entirely nigro-piceous the maculation may

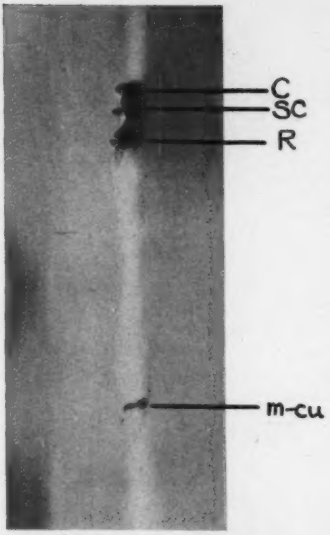

FIG 1.

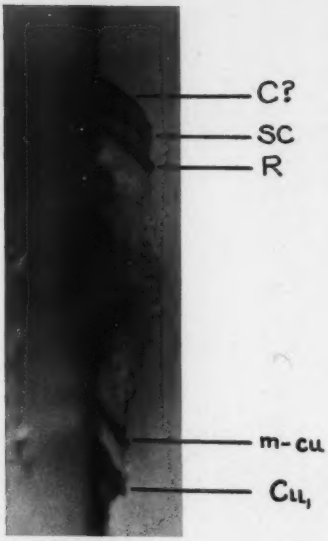

FIG 2

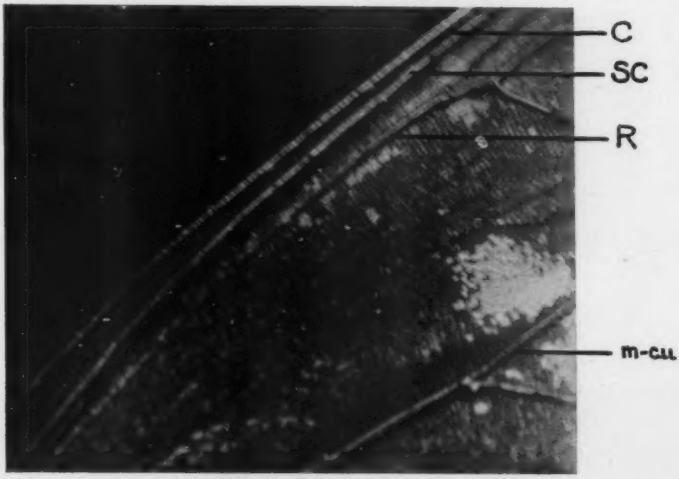

FIG 3

Fig. 1 Forewing of *Archonias tereas* Godart. Cross-section taken slightly basad of end of cell.

Fig. 2 Forewing of *Charonias eurytele* Hewitson. Cross-section taken slightly basad of end of cell.

Fig. 3 Forewing of *Archonias tereas* Godart. Portion of costal margin as seen from below. (Photographs by F. M. Brown)

be more or less defined by brownish hairs. Pubescence for the most part pale throughout, decumbent, of moderate length, not coarse and not concealing the surface; beneath more closely recumbent, denser on the apical margins of abdominal segments and mesosternal parapleura; shorter, finer and closely appressed on the legs. Head and pronotum with quite long, bristling, sparsely scattered setiform hairs; those of the elytra semierect and of moderate length.

Head moderate in size, as long as wide, five-sixths as wide as the prothorax, truncate at base and the occiput flattened and declivous; tempora arcuately convergent to the nuchal constriction. Frons feebly convex, sides distinctly margined, finely and evenly punctate. Eyes moderately large, prominent, circular in outline; facets convex and rather coarse, interstices with short microscopical setae. Antennae long and slender, extending almost to middle third of the elytra, slightly incrassate in distal five or six segments; segments two to six inclusive elongate, about three times as long as wide at apex, subcylindrical; seventh to tenth inclusive quite equal in length, seventh and eighth nearly twice as long as wide, ninth and tenth about one-half longer than wide, eleventh about twice as long as wide and one-third longer than tenth.

Prothorax relatively small and globular, as wide as long; sides strongly and semicircularly arcuate, narrowly constricted at base, the latter arcuate. Disk very strongly convex, arcuately defining the rather narrow submarginal basal impression; finely punctate, punctures separated by a distance equal to two to four times their diameters, surface not concealed by the pubescence which is directed inward from the sides but not notably reflected backward on the median line. Tomentose line at base not strong or dense, feeble at middle. Horn not broad, twice as long as wide, one-half wider than the crest, slightly constricted at middle and one or two denticles present; apical part rounded at apex with sides feebly arcuate, margin entire and narrowly reflexed, surface feebly concave and with radiating impressions; crest narrow, varying somewhat in length, sides very feebly arcuate, margin slightly irregular and converging in apical one-half to subacute apex, the latter not margined and rather declivous to floor of horn, surface flat and somewhat granular. Scutellum very small and very feebly entering between the elytra.

Elytra parallel, twice as long as wide and almost twice as long as prothorax from tip of horn to base; base transverse, a fourth wider than prothorax, humeri well exposed and rounded; sides scarcely at all divergent posteriorly, arcuately converging in basal third to the apical subdentiform salient, within which the apex is obliquely truncate, sutural angles rounded, slightly dehiscent at the suture. Disk feebly convex in basal third, thence gradually more convex, arcuately declivous laterally and apically, the extreme apex rather suddenly and briefly declivous; punctures slightly larger than on the prothorax and similarly spaced.

Body finely punctate beneath, last ventral segment more densely so and rather broadly arcuate at apex, surface with a shallow rounded impression against the slightly deflexed apical bead. Legs moderate in length and slenderness.

The sexes are difficult to separate by general facies. The females are a little heavier and resemble the males in color and sculpturing, the secondary sex-

ual characters are quite similar. The impression of the fifth ventral is a little more shallow and more densely punctate in the female and the elytral apices obliquely truncate in both sexes. The species has been described from the male, the type has the aedeagus partly exposed; the female or allotype has the abdomen more swollen and apparently gravid. None of the females studied have the retractile abdominal segments exposed.

Measurements of types: Length 3.5-4.0 mm.; width 1.2-1.4 mm.

Holotype, male, No. 4146, and *allotype,* female, No. 4147, in the author's collection, Museum of the California Academy of Sciences. Collected at Visalia, Tulare County, California, April 14, 1914, by Mr. F. T. Scott. A very large series has been studied. Specimens have also been received from Mr. Roy L. Wagner of Fresno, California. Paratypes are in the collections of Mr. Scott, Mr. Wagner and that of the author; a pair will be placed in the collection of Mr. Ralph Hopping, Vernon, B. C. Mr. Scott has stated that in April, 1934, large numbers were secured by use of chemical traps. At that time *visaliensis* was taken with *sparsus* Lec., *calcaratus* Horn, *constrictus* Casey and *robustus* Casey. *Sparsus* is a distinct species and not a synonym of *conformis* Lec as given by Dr. Geo. Horn is his synopsis of the species of *Notoxus,* according to H. C. Fall. *Sparsus* has semierect setiform hairs on the elytra, which *conformis* does not have.

The color is variable in *visaliensis,* usually the elytra are nigro-piceous and the maculation not recognizable, except by brownish pubescence; in the more or less rufo-piceous specimens the fascia and its extension basad is very distinct, it is not related to any of the pale species and distinct from the following dark or piceous species: *Microcerus* Casey has two transverse pale elytral fasciae and the pronotal horn is narrow; *montanus* Casey has a broad pronotal horn and the elytra are bifasciate; *nevadensis* is more robust, dull in luster and the pronotal horn is broad. *Bifasciatus* has the elytra piceous and shining, with two yellow fasciae and the apices rounded in both sexes, eastern in habitat and extending westward to Arizona and west of the Rocky Mountains. *Brevicornis* Fall has the elytra black with two pale fasciae and occurs in Arizona.

Notoxus obesulus n. sp.

Form robust, moderately ovate, about two and one-half times as long as wide. Color rufo-testaceous, elytra somewhat dusky; antennae, trophi and legs more or less testaceous; at times the elytra are more or less suffused with piceous; beneath the sterna and basal portions of the abdominal segments may be tinged with piceous. Luster somewhat dull to feebly shining. Frequently a transverse piceous fascia is evident just behind middle of elytra and which extends rather broadly along the suture, to gradually widen in basal fourth to involve the inner one-half of each elytron and scutellum at base. Pubescence moderate in length and fineness, abundant but not concealing the punctation, decumbent; somewhat longer on the pronotum and directed inward from the sides to be deflected backward on the median line; on body beneath somewhat sparse, denser on the parapleura and apical margins of the abdominal segments, shorter and appressed on the legs. Tomentose line not well developed, not dense laterally. Color of pubescence pale to albescent, more or less brownish on the piceous areas of elytra. Head and pro-

notum with sparse, long and bristling setiform hairs, those of the elytra shorter and more or less erect.

Head relatively large, about one-eighth narrower than the pronotum, widest across the eyes; frons slightly convex and flattened in the central area, occiput obliquely declivous to the nuchal constriction, vertex strongly convex, tempora arcuately convergent to base; surface finely punctate. Eyes evenly convex and prominent, slightly oval; facets convex and the interstices with sparse, short setae, Antennae extending over basal sixth of elytra, distal five segments feebly incrassate; segments two to nine subequal in length and twice as long as wide at apex; two to six inclusive, obconical and slenderest, seventh to ninth inclusive gradually less slender and subobconical; tenth suboblong, shorter than ninth and one-third longer than wide, eleventh pointed oval and about twice as long as wide.

Prothorax comparatively small, globular to slightly transversely oval, about as wide as long, not quite as wide as the elytral base; sides strongly and evenly arcuate, becoming a little straighter in basal one-fourth and briefly subsinuate before the angles; base broadly and feebly arcuate. Disk very strongly convex, arcuately defining the basal submarginal impressed area, the latter short; surface very finely punctate. Pronotal horn differing more or less in the sexes, slightly constricted at middle where there may be one or two denticles; apical part with margin entire and apex arcuate; crest rather narrow, elevated throughout, sides parallel, margin well defined, apex rounded, surface flat and granular.

Elytra about one-half longer than wide, in width quite equal to length of prothorax from tip of horn to base; base feebly emarginate, a little wider than the prothorax, humeral angle well exposed, rounded; sides feebly arcuate and a little divergent to about apical third, thence broadly arcuate and convergent apically; apices differing in the sexes, sutural angles rounded, slightly dehiscent at suture. Disk moderately convex in the central area, becoming more strongly arcuate and rather gradually declivous laterally and apically; finely punctate, punctures separated by a distance equal to two to three times their diameters.

Legs slender and of moderate length. Abdomen moderately convex and finely punctulate.

Male. Usually smaller and less broad across the elytra. Antennae rather more slender. Pronotal horn less dilated in apical one-half, sides feebly arcuate and margin narrowly reflexed; usually distinctly less than twice as wide as the crest. Elytral apices separately and obliquely truncate with the external angles subdentiform. Apex of fifth ventral abdominal segment shorter and more broadly arcuate.

Female. Usually larger and more robust. Antennae a little less slender. Pronotal horn more dilated in apical one-half, margin quite semicircularly arcuate and more widely reflexed with the surface more concave; distinctly more than twice as wide as the crest. Elytral apices broadly conjointly subtruncate. Fifth ventral a little longer with apex more strongly arcuate.

Measure of types: Length 3.0-3.75 mm.; width 1.4-1.25 mm.

Holotype, male, No. 4148, in the collection of the author, Museum of the California Academy of Sciences.

Allotype, female, and two paratypes have been placed in the Canadian National Collection, at Ottawa. Collected at Shingle Creek, near Summerland, B. C., by Mr. Hopping, May 26, 1931. Paratypes in the collection of the author and that of Mr. Hopping. A pair will be placed in the collection of H. C. Fall, Tyngsboro, Massachusetts, and in that of the National Museum, Washington, D. C. A large series has been studied, part of which was collected at Osoyoos, British Columbia, May 4, 1929.

Obesulus most closely resembles *cavicornis* Lec. in facies. In the latter species the form is slightly robust, surface partly hairy, the elytral post-median piceous fascia sends processes from the front and hind margins of an indefinite extent, there may be some diffusion of the piceous markings; the pronotal horn is narrow and not serrate, it occurs in Southern California (San Diego) and as far north as San Francisco.

Dr. Geo. Horn believed that *cavicornis* occurs in Nevada. Its type of maculation is different from that of *obesulus* and it is to be expected that variations will occur in the markings by contraction or diffusion. Specimens from Truckee, California, are quite like those from British Columbia in color and maculation. Yet, I have not seen any that have the irregular fasciae of *cavicornis* although the color is similar. Specimens from the different geographical areas were submitted to Prof. H. C. Fall, who could not place the species and thought that some might be *cavicornis* suffused with piceous.

In specimens of *obesulus* the form is on the average larger and more robust; pubescence denser and somewhat coarser, more intermixed with brownish and the luster duller. *Conformis* Lec. is without erect hairs on the elytra, while *sparsus* Lec. has the facies of *conformis,* the elytra have erect hairs and in both the pronotal horn is narrow. In *obesulus* the piceous markings of the elytra are of a different type and often not distinguishable on account of the piceous diffusion.

After most careful examination of the Truckee and Carson, Nevada specimens I can say that they are not *obesulus,* as the elytral apices are distinctly different; neither are they *cavicornis* as the apex of each elytron is less rounded, more pointed and the subdentiform angle more feeble and thence more briefly arcuato-subtruncate with the broadly rounded sutural angles, as well as greater dehiscence at the suture; the pronotal horn is not so broad apically. The Truckee, California and Nevada specimens evidently represent a distinct and undescribed species. Specimens from Carmel, Monterey County, Point Reyes, Marin County and San Francisco, are readily referred to *cavicornis* Lec.

TABANUS RHOMBICUS AND RELATED WESTERN HORSEFLIES.

BY CORNELIUS B. PHILIP,[1]

U. S. Public Health Service, Hamilton, Mont.

The dark or grayish bodied horseflies, superficially resembling *Tabanus rhombicus* O. S. or its variety *osburni* Hine, are among the abundant and troublesome species encountered in western and boreal North America. Four new species and the previously undescribed males of 6 others, together with a rather

1. Contribution from the Rocky Mountain Laboratory, United States Public Health Service, Hamilton, Montana.

widely scattered literature have suggested the value of bringing together some notes on this rather heterogeneous group. Most of the species have 3 rows of pale markings on the abdomen, but a few are black with little or no indication of pattern; all here included have been placed in the subgenus *Therioplectes*, with hairy eyes in both sexes and an ocelligerous tubercle in the females. The numbers of specimens actually seen by me from various western states are included.

T. itasca n. sp.

Female—length 12 mm. Has somewhat the appearance of a faded specimen of *T. typhus* Whit., in which all the light maculations are enhanced, approaching *T. nivosus*. Eyes pubescent; tongue and stylets unusually short, barely longer than the palpi; front broad, slightly convergent at the frontal callosity, which is pale yellowish-brown, quadrate, and touching the eye margins. Antealar tubercles yellowish. Abdomen dark brown with 3 rows of pale triangles, the largest on the 2nd segments, and the lateral rows rhomboid and pale flesh-tinted.

Head with front buff and brownish pollinose with short appressed black hairs, the ocelligerous tubercle, small but contrasting shiny brown, a median dark brown, rather wide denuded line hardly connected with the yellow callosity below. Subcallus, face and cheeks grayish pollinose, creamy near the base of the antennae and palpi. Antennae, pale reddish, darkening distal of the middle of the third segment, which is slender, the basal prominence slight. Palpi yellowish with short appressed black and white hairs intermixed, plainly more incrassate basally and pointed apically than in *typhus* or *astutus*. *Thorax* dark with 5 gray lines its full length. A pale reddish humeral line involves the humeral and antealar tubercles, darkening inferiorly on the pleura. Scutellum dark with some pale hair caudad. *Legs* reddish, darker on the coxae, trochanters and tarsi. Wings hyaline, veins yellowish, stigma not intensely infuscated, no stump-vein present at the bifurcation of R5. Halteres dark reddish. First segment of the *abdomen* pale with a dark emarginate spot beneath the scutellum. Incisures of the second and following segments pale expanding mesally into small grayish triangles, the largest on the second segment where it is acuminate and almost cross the segment. The lateral rows of rhomboid spots very prominent. Venter pinkish, darker apically.

Holotype—Itasca Park, Minnesota. July 17, 1930, L. W. Orr. In the collection of the University of Minnesota.

Paratype—♀ same locality and collector. August 18, 1928. Essentially the same, a little darker as regards antennae, thoracic and abdominal patterns, and is less well preserved. The rhomboidal spots are slightly smaller and have a more pronounced pinkish cast. In the collection of the author.

The wide front with yellowish callosity, somewhat swollen palpi, short mouth parts and rhomboidal lateral spots on the abdomen, with a general pinkish cast to the whole body will distinguish this from related species of the *astutus* group.

Named for the locality which is the birthplace ("true head") of the Mississippi River.(2)

(2) Dr. R. W. Dawson informs me, the name Itasca (from "ver (itas + ca) put") used as a noun in apposition does not have to agree in gender with *Tabanus* and so is here preserved intact, though doubtless some future student will make the change to "itascus."

Tabanus hearlei n. sp.

Female—length 11.5 mm. Has the build and appearance of dark specimens of *T. typhus* Whit. Eyes pubescent, proboscis about twice the length of the palpi; frontal callosity piceous usually merging broadly into the extension above, which tapers gradually to about half the height of the front; antealar tubercles black; 3 rows of gray triangles on the abdomen, which are the expansions of narrow gray posterior margins, largest on the second segment with no red beneath, and wings hyaline, a trace of a cloud at the bifurcation of vein R5 (sometimes a short spur present), the costal and first M cells deep yellow.

Head with front, subcallus, face and cheeks gray pollinose, the first beset with short black hairs but without a brownish overcast, the face and cheeks with long gray hairs, a slight yellowish tinge near the base of the antennae. Latter black, the third segment dark reddish basally, rather slender, and basal prominence slight. Palpi dirty yellowish, very slender, about 2/3 length of stylets and ½ length of the extended tongue, shaggier appearing and more pointed than in *typhus*. Ocelligerous tubercle prominent, blackish. Thorax with dark brown integument and 5 gray stripes; antealar tubercles and scutellum black; pleura dark gray with smoky pile. Legs blackish, the knees and bases of the tibiae dark brownish. Central *abdominal* triangles acuminate above the middle of each segment, the proximal sides of the lateral rows somewhat oblique, but not forming oblique dashes as seen in some related species. Venter smoky, the incisures grayish pollinose and the whole beset with grayish appressed hair, darker toward the tip.

Holotype. Fog Horn Mountain, Birch Island, British Columbia. July 18, 1928, Eric Hearle. In the collection of the author.

Paratype ♀'s—One, same locality, August 8, 1933, 6,000 feet, on horse; 3, same locality, tributary to Boulder Creek, August 10, 1933, 6,000 feet, on horse, T. K. Moilliet; 1, N. base Granite Mtn., Birch Island, 10 a.m., August 9, 1933, 6,000 feet, on horse; 1, E. Coast James Bay, Quebec July 19, 1920, F. Johannsen; and 1, Hamilton River, Labr., July 12, 1919, S. F. Arthur (last 2 determined by Stone). In collections of the Ohio State, Canadian and U. S. National Museums, and of the author.

This species resembles *typhus* very closely in size and abdominal pattern, but the black antealar calli, long mouth parts, more pointed and relatively shorter palpi, broadly produced frontal callosity above and very deep yellow first M cell at the base of the wings will distinguish it, while the closely related *astutus* is generally larger, particularly the abdomen on which the triangles are usually more pronounced and reddish laterally, the frontal callosity is quadrate, the mouth parts shorter in relation to the palpi and the first M cell mostly subhyaline.

Named in memory of the collector, the late Eric Hearle, a most diligent and enthusiastic student of biting flies, in whose death investigations of biting flies in North America have suffered a real loss just as he was entering upon the most productive period of his career in Canadian entomology.

T. laticallus n. sp.

Somewhat the appearance of small *astutus* O. S. with 3 rows of gray triangles and narrow yellowish posterior incisures on a dark abdomen. Wings including costal cell hyaline with brown veins and stigma; no stump-vein present.

Thoracic lines evanescent; humeral tubercles red, antealar tubercles practically black. The lower frontal calli of the ♀ unusually swollen, wide and shallow.

Female—12 mm. Eyes, indistinctly and sparsely pubescent, with 3 stripes and lower border purple (relaxed). Front very wide, sides strictly parallel, height about 2.5 times the width, grayish; ocelligerous tubercle small but prominent, the median ocellus only, visible; callosity very swollen, occupying full width of front and extending upwards and inwards laterally to meet the median callosity, thus enclosing a depressed, rounded spot of gray pollen, in consequence of which spot the callosity is very shallow vertically. Subcallus grayish pollinose, also very shallow and swollen, width over 3 times the height at the median sulcus; the sulci very deep, forming a rather flat topped "Y", the lateral arms of which below the callosity are each longer than the median stem. Face and cheeks gray pollinose with rather sparse, short gray hairs. Tongue short, labellae large. Second palpal joints rather short and chunky, yellowish with short appressed black hairs, abruptly rather than gradually attenuated apically and not as recurved or pointed as in typical *astutus*. Antennae, first 2 joints dark brown, grayish pollinose and covered with blackish hair; third joint rather slender, the dorsal prominence rounded and reddish only on the extreme base. Legs dark brownish, paler proximally on the tibiae (tarsi missing). *Abdomen* with the lateral gray spots most prominent on the first 3 segments; and no reddish ground color; median triangles subobsolete, but probably as a consequence of some "rubbing"; incisures narrowly yellowish. Venter, dark brown with pale posterior margins.

Holotype—Greenbush, Minnesota, July 15, 1925. C. B. Philip. Taken in a spider web in the railway station, and therefore a little rubbed dorsally and some parts of legs broken. In the University of Minnesota collection.

The facial characters with wide front and wide, shallow, swollen frontal callosity and almost "chevron-shaped" subcallus, and deep sulci, and less slender, relatively shorter palpi distinguish it from *astutus*, its closest ally; the short proboscis and hyaline wings, in addition, from *hearlei;* the narrow antennae, dark antealar tubercles and hyaline costal cell as well as the frontal characters, from *typhus*.

T. liorhinus n. sp.

(Gr., smooth + snout) *Female*—length 12.5 mm. Much the appearance of *T. microcephalus*. Eyes hairy (very short) the pattern with 4 green bands on a purple ground including the upper and lower margins. *Head* shallow, unusually wide, the outer eye margins evenly rounded; front gray, rather wide, slightly convergent below; ocelligerous tubercle very reduced; the callosity large, merging broadly with the spindle-shaped median callus, above, the subcallus relatively small, denuded, the whole piceus with a faint brownish tinge at the top of the median sulcus. Antennae slender, the first 2 joints pale red, the third black with a reddish tinge at the extreme base, hardly produced dorsally. Palpi pale yellowish, very incrassate basally on the second joints, rapidly and sharply acuminate, with scattering short black hairs on the outer distal half, and longer white ones basally and on the whitish pollinose face and cheeks. Proboscis rather short, little longer than the palpi. Disc of *thorax* and scutellum dark with indications of gray lines anteriorly; antealar and humeral tubercles broadly reddish which extends onto the pleura and with scattering black and white pile intermixed. Legs,

including the fore coxae reddish, a little darker distally on the tarsi and fore tibiae. Wings hyaline, the stigma and veins brown; right wing only, with a short stump-vein and faint indications of a cloud at the bifurcation of R5 on both. *Abdomen* dark with 3 rows of gray triangles and a slight brownish tinge laterally; lateral triangles oblique and touching the hind margins only on segments 2 and 3, rather rounded from the third segment on. Venter dull reddish.

Male—11.5 mm. Body somewhat more shiny and in general darker than the ♀, the red on the sides of the abdomen more pronounced. Stump-veins on radial sectors of wings moderate. Head proportionately, somewhat larger than the ♀, eyes plainly pilose; the vertical triangle not much raised above the upper eye level, light brown, subshiny; frontal triangle dark grayish pollinose, but brown and subshiny in the apex; antennae as in the ♀ but narrower; palpi reddish with black and white hairs intermixed, the apical segments swollen (length is to thickness as 1.6:1). Gray lines on disc of thorax only suggested anteriorly. Legs brownish, darkening distally. Abdomen broadly, deep reddish on the sides of the second to fifth tergites, the inner margins jagged by reason of the central black dashes; the 3 rows of pale maculations seen in the females only suggested in this sex by scattering pale hairs. First segment almost entirely dark. Venter dull reddish.

Holotype ♀—Salmon Lake, Nicola Dist., British Columbia, Aug. 8, 1930, H. Mobley. In the Canadian National Collection, Ottawa.

Allotype ♂—Red Lake Falls, Minn., Aug. 8, 1934. C. B. Philip, sweeping. In the collection of the author.

Paratype ♀'s—11.5 to 13.5 mm. One Bilby, Alberta, Aug. 10, 1924, O. Bryant on "Golden Rod." One Ungava, Labr., "8-12." L. M. Turner. Five Baddeck, Cape Breton Island, Nova Scotia, July 18, 27, 31 and Aug. 27, 1928. In the collections of the U. S. National Museum, Museum of Comparative Zoology (Boston) and the author through the kindness of Dr. Alan Stone. Five through Dr. J. McDunnough from the following locations in Manitoba: Teulon, July 18, 1923, A. J. Hunter; Winnipeg, 1920, G. F. Dalman; (2) Husavick, Aug. 23, 1910, Coates; and one without other locality data. In the Canadian National Collection. Also one, Deer River Minn., Aug. 10, 1915. In the Univ. of Minn.

The stump-vein is pronounced on both wings in all but one of the paratypes. In well preserved specimens, the red on the sides of the abdomen is obscure, while the 3 rows of triangles are quite prominent; normally the small black median callus is hardly confluent with the frontal callosity, while the ocelligerous tubercle, is small but a conspicuous yellowish. Occasionally the gray pollinosity of the face, has a tendency to encroach on the edges of the shiny subcallus, and the dorso-basal tooth may be slightly more pronounced than in the holotype.

The denuded subcallus and the reddish shoulders and antealar tubercles readily separate it from *microcephalus,* and the reddish legs, in addition from other related species.

*T. **rhombicus*** O.S. The typical form with rather dull black and grayish pollinose appearance, the abdominal triangles very distinct, and frequently underlain laterally with reddish confined to the triangles, predominates in Colorado and the southern range limits of the species, while the blackish, subshiny variety

osburni Hine is the common form to the northward and one of the economic species especially in mountainous regions. Intergrades in large series make impossible continued specific retention of the latter, a conclusion concurred in by Stone (correspondence); although definite lines cannot be drawn, the name is useful for designation of a variety, extremes of which may totally lack the abdominal triangles. Dark specimens of *T. rupestris* McDun. approach *osburni*, but the sides are redddish to flesh pink usually well beyond the outlines of the lateral triangles; the 2 occur together in abundance in the Bitterroot Valley and have seemed readily separable on casual observation even though lacking in structural differences. The ♂ of *osburni* has been described by Hine.

Minn. 5 ♀; Wyo. 6 ♀; Colo. 1 ♀; Mont. 336 ♀; Ida. 10 ♀; Utah 4 ♀; Ore. 1 ♂, 24 ♀; Wash. 17 ♀; Brit. Col. 57 ♀; Alta. 6 ♀; Sask. 3 ♀.

T. sequax Will. Western Mont. 9 ♀; Ida. 1 ♀; Ore. 14 ♀; Wash. 5 ♀; Brit. Col. 6 ♀.

T. sexfasciatus Hine. Alaska 8 ♀; Yukon 2 ♀; (known from eastern Canada, Siberia and western Europe, see Stone, 1935).

T. procyon O. S. The male of this small, shiny black species has not been described. The species is the earliest tabanid on the wing in western Montana, having been taken as early as March 22. It is never abundant and prefers the semi-sheltered, higher mountain canyons and draws.

Allotype ♂—12 mm. Easily associated with the ♀. Not much difference in the size of the eye facets. Subcallus, face and cheeks, and palpi swollen, shiny black. Outer front tarsal claws noticeably elongated. Antennae more slender. Legs and wings and remainder of body as in the ♀. Corvallis, Oregon, May. In the collection of the author.

Western Montana, 1 ♂, 22 ♀; Ore. 4 ♂, 6 ♀; northern Calif. 6 ♀; "North Bend" (Sask.?) by Hadwen, 1 ♀.

T. laniferus McDun. Very like the above superficially but the head characters are quite different; more northern in its occurrence and appears later in mid-summer. Body typically shiny black, but occasional specimens show brownish tendencies. A specimen from British Columbia before me has decidedly yellow palpi, brownish legs, and relatively large, reddish patches on the sides of the second segment. Both sexes were described by McDunnough.

Alaska 1 ♀; Brit. Col. 5 ♀; Alta. 5 ♀; Ore. 3 ♀; Wash. 26 ♀; Ida. 1 ♀.

T. astutus O. S. Comparison of a ♂ of this with ♂'s of *T. typhus* Whit. appears to confirm Stone's opinion of the distinctness of these 2 species, doubt concerning which has been raised by Bequaert and others. Each diagnostic character in occasional females shows variations suggesting intergrades, but on the whole, the proportionately larger abdomen with more distinct grayish triangles usually underlaid by reddish laterally, more hyaline costal cells, black antealar tubercles, relatively shorter, more pointed and coarsely hirsute palpi, and less angulate, darker antennae distinguish *astutus* ♀'s.

Allotype ♂—11.5 mm. (probably short due to somewhat retracted abdomen). Little difference in size of facets. Antennae reddish, infuscated distad of the basal prominence of the 3rd segment; latter not excavated dorsally, the basal angle slight. Second palpal joint deep yellowish, small, subequal to the basal joint

in length, less than twice as long as thick. Thorax with distinct gray lines its full length, the antealar tubercles black, covered with gray pollinosity. Legs brownish, darker on the femora and tarsi. Costal cells of wings subhyaline. Abdominal pattern as in the female, with a broadly reddish ground color laterally on segments 1-4 inclusive. Venter with a reddish cast. Beltrami Co., Minn., Aug. 9, 1910. Compared below with *T. typhus*.

Brit. Col. 6 ♀ ; Alta. 1 ♀ ; Minn. 1 ♂, 16 ♀, East.

T. typhus Whit. Two ♂'s before me have somewhat the appearance of those of *T. illotus*, but the slender palpi quickly differentiate them. There is more reddish in the lateral ground color of the abdomen than in the ♀'s, but the reddish characteristic antennae and antealar tubercles, and association of a typical ♀ with the allotype, both reared four days apart by the same collectors, make the assignment definite in my estimation. The ♂ will be described by comparision with that of *astutus* above.

Allotype ♂—11 mm. The head appears relatively a little larger and the abdomen smaller than in *astutus*, while the line of demarcation between the large small facets is sharper. Antennae red with the annuli black, 3rd joint slightly excavated and a distinct though slight tooth, thus corresponding with the ♀, though more slender. Palpi yellowish, smoky on the basal segments, the apical ones distinctly longer, over twice their thickness. Thorax blackish, faint indications of gray lines only anteriorly in certain lights; antealar tubercles red. Outer front tarsal claw a little longer in this, the coxae and femora black, the tibiae and tarsi brownish. Costal cells of wings dilute yellowish. Abdominal triangles reduced, the dark reddish ground color confined to the sides of segments 2 and 3. Venter dark, the incisures pale, and reduced, brownish indications anterolaterally. West Springfield, Mass. June 22, 1916, Ricker and Smith (also bears label Agawam, Mass.). In the collection of the author through the courtesy of Mr. Nathan Banks. Another male, Cranberry Lake, N. York, July 22, 1920, agrees closely.

Pupal "aster" (♂) very like *T. lasiophthalmus* with the median teeth very pronounced. Approximately six teeth in the dorso-lateral and lateral combs and 32 in the ventro-caudal fringe. Segmental spinose fringes complete, the long spines most numerous laterally, heavy, short spines predominating mesally. Frontal carinae hardly developed, mere rugosities; rima of thoracic spiracles curved but not hooked cephalad. Would run to *trimaculatus* in my key to pupae (1931) but the marked difference in frontal carinae would quickly separate this.

Brit. Col. 4 ♀ ; Mont. 2 ♀ ; Minn. 156 ♀ ; East.

T. opacus Coq. Hine (1904) undoubtedly had the ♀ of *hirtulus* confused with this and specimens thus misdetermined by him have been studied. On the other hand, he describes the ♂ correctly. I have reared 11 larvae, all ♂'s, taken in grassy hummocks below a desert spring near Three Forks, Mont. The larvae are reddish, resembling somewhat those of *T. lasiophthalmus*. Pupae with 3-5 spines in the dorso-lateral and lateral combs and about 20 long and short spines in the ventro-caudal fringe. The "aster" much like that of *typhus* above, the median teeth very strong. Segmental fringes complete, the long and short spines rather evenly distributed. Rima of thoracic spiracle curved and moderately

hooked cephalad. Frontal carinae produced mostly mesad and contiguous. It is very like *T. illotus* and would run to that in my pupal key but is readily distinguished by the much larger 1st abdominal spiracle, which is fully ¼ the length of the thoracic spiracle, while that of *illotus* is less than 1/6 that of the thoracic spiracle, and the "hook" of the latter is more pronounced.

None of the ♂'s have stump-veins, and all have a pronounced reddish cast to the abdomen. Eye facets hardly differentiated in size, antennae red basad of the dorsal tooth, slight dorsal excision on the third segment. Outer front tarsal claw but slightly elongate. This sex is readily associated with the ♀.

Mont. 11 ♂, 23 ♀; Wyo. 3 ♀; Colo. 7 ♀; Utah 48 ♀; Northern Calif. 1 ♂, 1 ♀.

T. melanorhinus Big. Appearance very close to darker, subshiny specimens of *opacus,* but much more variable in size (12-15 mm.) and lateral reddish on the abdomen in dark variations being practically confined to the dashes on the second segment. I have not seen the ♂.

Western Mont. 19 ♀; Brit. Col. 4 ♀; Wash. 1 ♀; Ore. 3 ♀; northern Calif. 13 ♀.

T. hirtulus Big. In this journal (1935, 67: 93), I discussed the probability that *T. tetricus* Mart. was a less common form of *hirtulus* with denuded subcallus, but if so, as called to my attention by Dr. Alan Stone, the name of the atypical form by Marten is the older (of which the type is lost) making unfortunate priority. The important character of long stump-veins is not mentioned by Marten, and Hine listed *tetricus* as "not identified" in his study of western species. There may be those, therefore, who feel that the description applies to something else, as *opacus,* or the name suppressed. Although I am satisfied the 2 names apply to variations of one species, I am associating the male with the name that is both certain at present and applied to the dominant form.

Allotype ♂—14 mm. A little darker than the average ♀ but the dark antennae, the tumescent, pallid palpi, presence of stump-veins, and characteristic abdominal pattern with lateral flesh-colored dashes easily associate the 2 sexes. Eye facets little differentiated. Antennae black, reddish on the extreme base of the third segment which is slightly produced dorso-basally. Apical palpal joints swollen, about half again as long as thick; a slight downward pointed nipple at the tip. Thorax black with indications of short, grayish lines anteriorly. Legs black, brownish proximally on the tibiae. Costal cells of wings clear, a slight cloud at the bifurcation of R5, the stump-vein on the right wing evanescent, but long on the other. Abdomen with three rows of triangles, laterally oblique and underlaid on tergites 2 and 3 by reddish which extends broadly onto the corresponding sternites. Bozeman, Mont. June 30, 1925, C. B. Philip. In the collection of the author.

Four other ♂'s from Mont. and 1 from Colo. are before me, all somewhat reddish on the sides, but pronounced in the last approaching *opacus.* The stump-veins are less pronounced in this sex but indications at least, are present in all. Antennae are black in all, but 2 otherwise agreeing, have the reddish basal segments of *tetricus.* Front tarsal claws, subequal in all, but longer and more slender than usual.

Brit. Col. 4 ♀ ; Alta. 3 ♀ ; Sask. 1 ♀ ; Man. 2 ♀ ; Ore. 1 ♂, 6 ♀ ; Calif. 1 ♀ ; Utah 2 ♀ ; Ida. 1 ♀ ; Mont. 5 ♂, 297 ♀ ; Wyo. 2 ♂, 5 ♀ ; Colo. 1 ♂, 9 ♀.

T. microcephalus O.S.: Minn. 3 ♀ ; East.

In presenting a key to the group, it may be mentioned that Hine (manuscript notes) studied *T. comes* Wlk. and *T. leucomelas* Wlk. in the British Museum and considered both to be related, comparing the former with "the grayish elongate specimens he placed with question under *astutus* O.S.", and the latter (type badly greased) doubtfully with *comes*. However, *comes* was described without a head, and Osten Sacken (1876, p. 473) mentions seeing 5 specimens of 3 different species under the name at the British Museum in 1859, 11 years after appearance of the description. While the specimens at present under that name in the Museum might well coincide with *astutus*, it appears impossible to adopt the name in place of *astutus* and study of the headless type is even doubtful of clarifying the confusion. The locality of *leucomelas* (Georgia) also throws doubt on its identity with any of the species keyed below, and the 2 names are therefore disregarded. The males of *melanorhinus, sexfasciatus,* and *sequax* in addition to the new species, are unknown to me.

KEY TO THE RHOMBICUS-ASTUTUS GROUP AND RELATED BLACK OR GRAYISH-BODIED, BOREAL NEARCTIC HORSEFLIES.

1. Subcallus of female denuded, shining 2
" " " dull, pollinose 7
2. Antealar tubercles and palpi black; a small, shining black species without evidence of abdominal triangles .....*procyon* O.S.
Antealar tubercles or palpi, or both, reddish 3
3. Antealar tubercles black 4
" " reddish 5
4. Body rather dull black, abdominal triangles distinct, the lateral ones on the 2nd segment frequently superposed on a restricted reddish tinge ..... *rhombicus* O.S.
Body shining black, the triangles usually faint or almost wanting, no reddish laterally ..... *rhombicus* var. *osburni* Hine
5. Femora black; front of female strongly convergent below 6
" red; " " " only slightly convergent below *liorhinus* n. sp.
6. Size small, 10 to 13 mm.; wings without stump-vein on bifurcation of R5; body rather shiny ..... *melanorhinus* Big.
Size medium, 13 mm. or over; stump-vein present; body dull grayish-black ..... (some *hirtulus* Big.)
7. Antealar tubercles black 8
" " reddish 14
8. Antennae entirely black; palpi black, at least outwardly 9
" with some red, at least on 3rd segment basally; palpi pallid or at most, dirty yellowish 10
9. Size rather small, 12 to 14 mm.; wings clear; abdomen without evident triangles; palpi sometimes reddish or even yellowish inwardly .....
..... *laniferus* McD.

Size medium, 14 to 16 mm.; outer cross-veins of wings clouded; abdominal triangles distinct, palpi entirely black ..... *sequax* Will.

10. Femora red; 2nd palpal joints of female strongly swollen basally and attenuated distally ..... *microcephalus* O.S.

Femora black; palpi mostly slender 11

11. Front of female hardly 2½ times as tall as wide, callosity and subcallus very wide and shallow; palpi rather chunky, short ..... *laticallus* n. sp.

Front with height at least 3 times the width at the callosity, the calli not unusual; palpi slender 12

12. Abdomen with distinct rows of gray triangles, sometimes pinkish beneath, laterally 13

Abdomen without such rows of triangles, reddish laterally on the second segment ..... *sexfasciatus* Hine

13. Proboscis unusually elongate, about twice the length of the palpi; abdomen normal in size without pink beneath the lateral gray triangles ..... *hearlei* n. sp.

Proboscis normal, palpi about two-thirds its length; abdomen usually abnormally large, frequently pinkish laterally ..... *astutus* O.S.

14. Femora reddish; frontal callosity yellowish ..... *itasca* n. sp.

" black or grayish pollinose; callosity black or dark brown 15

15. Size rather small, 13 mm. and under; no stump-vein on bifurcation of vein R5 of wings 16

Size medium, over 13 mm.; a pronounced stump-vein present . *hirtulus* Big.

16. Abdominal triangles pronounced, with decided reddish ground-color laterally; palpi of ♀ pale and chunky basally ..... *opacus* Coq.

Abdominal triangles smaller, seldom with faint reddish on the sides of the second segment; palpi of ♀ slender, yellowish ..... *typhus* Whit.

Notes on 2 additional western species, not included in the above group but with troublesome taxonomic relationships, are here appended.

T. orbicallus n. sp.

Of the *gilanus* group of western horseflies having a rather wide head, pubescent eyes, no ocelligerous tubercle, and three rows of prominent triangles on the abdomen, the lateral ones oblique.

Female, 14 mm. Eyes laterally produced with sparse, very minute hairs, and with a greenish sheen and indications of purple stripes in some specimens even in the dried condition; (relaxed) with a wide lower border and two outwardly abbreviated stripes purple on greenish ground. Front wide, a little less than 1/3 its height, plainly convergent below; yellowish pollinose, vertex darker and with short blackish hairs; frontal callosity dark brown, almost round in outline except for slight extensions of the upper corners, narrowly separated from the eye margins, and connected narrowly above with a rather broad, ellipsoidal median callus of the same color. Subcallus yellow pollinose, extending laterally on the face at the level of the antennae. Face and cheeks otherwise pale creamy gray, and, with the palpi, covered with whitish pile. Not over a dozen scattered short black hairs on either second palpal joint. Latter flesh-colored, rather long, swollen basally and tapering evenly to a sharp point apically.

Proboscis black, normal in size. *Thorax* dull blackish on the disc, indistinctly lined and with short appressed rufous hairs, pleura pale pilose and pollinose; antealar tubercles pale yellowish with sparse blackish hairs. Wings including costal cell hyaline with tan veins and stigma; cell R5 broadly open and no stump-vein above. Legs pale reddish, the trochanters, fore tibiae at the extreme tip, and all tarsi darker, accentuated on the front pair; hind tibiae with outer fringe of hairs very sparse, black and white intermixed. Abdomen dark brownish, the central row of pale triangles narrow and continuous, the lateral rows of oblique pale brownish and buff dashes crossing the segments also, smaller caudad. Venter pale reddish and pale pilose, an ovoid dark maculation on the first and part of the second segments mesally and a few dark shades on the extreme edges of the segments; some black hairs on the last 2 segments.

Male, 12 mm. Like the female except the usual sexual differences. Eyes with facets hardly differentiated, the pubescence short. No black hairs on the palpi. Fore tarsal claws subequal.

Holotype ♀—Gove Co., Kansas, 2813 ft. (no date) F. X. Williams. In the collection of the author. Bears 2 labels of *T. insuetus*, one photographic "by Hine" for which he may not have been responsible.

Allotype ♂—Scott Co., Kans. June 19, 1925. R. H. Beamer. In the collection of the U. S. Nat'l. Museum.

Paratypes. Females, one each with same data as allotype, and from Yankton, S. Dak. June 12, 1929, H. C. Severin, Ames, Iowa, June 19, 1919, Onaga, Kansas, June 2, 1926, Crevecoeur, and Atchison Co. Kansas, July 10, 1924, R. H. Beamer; males one each from West Point, Nebr., June 24, 1905, H. S. Smith (listed by Wehr, 1922, as *T. dodgei* ♂) and Ness Co., Kans. 2260 ft. F. X. Williams, July 7, 1912, the latter with a photographic label of *T. insuetus* by Hine as on the holotype. In collections of U. S. National Museum, Canadian National Collection, the Univ. of Nebr., Kansas State College and the author.

Separated from related species by the all reddish (except fore pair distally) legs. The S. Dak. specimen has the appressed, deep rufous hairs on the thorax especially pronounced.

T. (*Atylotus*) *insuetus* O. S. is a not uncommon western horsefly which presents perhaps as many puzzling variations and taxonomic problems as any group in the fauna concerned, and resembles *T. bicolor* Wied. of the east in this respect. Practically all of the characteristics of diagnostic stability in other species are here found to vary structurally and / or especially tinctorially, and reference to the description of Osten Sacken's original 12 fmales from Webber Lake, California, emphasizes this wide latitude. Similarly, series of specimens taken simultaneously in other localities show remarkable differences in structure and color, so that it is difficult to decide whether the species is composite or merely widely variable. Many of the characters go beyond the original (although detailed) description and clarification of the problem will require many specimens of both sexes from a large number of localities. The males, of which the writer has 4 likewise variable, have been seen hovering in sunny places on high mountain peaks where they were difficult to capture. Discovery of this sex, which Osten Sacken pronounced of importance in elucidation of its taxonomic relationship,

leaves no doubt of the correctness of his assignment to *Atylotus,* with closer affinity in some respects to the European *fulvus* and *rusticus* than to *bicolor* of this country.

A male from western Montana, agreeing closely with a cotype provided the writer through the courtesy of Mr. Banks of the Cambridge Museum of Comparative Zoology, is here described.

Allotype—11.5 mm. *Head* wider than the thorax, sub-equal in size to that of the ♀ (not subhemispherical as in *bicolor*); eyes yellowish (dried), pubescent, upper facets not markedly enlarged, about 2/3 the total area and delimited below by the usual incomplete, slender brown stripe; vertical triangle pale pilose, set below the upper eye level. Frontal triangle and face whitish and pale hair below. Palpi pale creamy, swollen, little more than ½ as thick as long, slightly projecting downward apically, with black and white hairs; tongue short; antennae rather slender, pale brownish darkening on the annuli, the third segment slightly excised and with a distinct basal prominence. *Thorax* as in the ♀ but no appressed hairs and the dorsal pile sparser and longer; wings with costal cells brownish and moderate stump-veins present; legs blackish, the knees, fore tibiae basally, and middle and hind tibiae yellowish. Abdomen blackish, cinereous dorsally and ventrally with reduced yellowish laterally above and below on the first 2 segments, the median triangles hardly apparent except for sparse, pale hairs in certain lights (absence of these triangles in some specimens was attributed by Osten Sacken to wear, but the co-type before me and many specimens in series from identical localities have the vestiture well preserved, but the rows of markings obsolescent); hairs on the sides and venter pale and longer than in the ♀. Blue Nose Peak, Mont. Idaho Divide, Ravalli Co., July 23, 1933. C. B. Philip. In the collection of the author.

Of the variations encountered, one dark rust-colored form goes sufficiently beyond the latitude of the original description to warrant at least varietal treatment pending accummulation of adequate materials for further differentiation or identity.

T. insuetus var. **tingaureus** n. var.

(Latin, tarnished gold) ♀. *Head* of the usual shape, wider than the thorax, eyes chocolate brown (dried) without evidence of the usual darker stripe, pubescence hardly discernible, front wide, yellow, the calli moderate in size, piceous, quadrangular, the lower wider than high, the median taller than wide, a small denuded spot in the middle above the latter. Subcallus, face and cheeks deep yellow and with fulvous pile below and on the first palpal joint; black denuded spots beneath each antenna and at the facial apodemes. Antennae, including the annuli, and palpi orange yellow, the latter of the usual shape and black, appressed hairs distally. *Thorax* deep golden pollinose and pilose laterally, the dorsum not perceptibly lined, with sparse yellowish and black pile and appressed golden hairs. Legs deep reddish, infuscated on the coxae, basal 1/6 of the fore femora and distal ½ of fore tibiae and tarsi, basal 1/3 of the mid-femora, and basal ½ of hind femora. Wings hyaline with the costal cells dilute yellowish, a short "stump-vein" present on one wing only. Abdomen deep golden or rusty yellow pollinose and appressed pilose, with some blackish hairs laterally in certain lights, no indica-

tions of maculations except the second segment somewhat more orange laterally.

Holotype.—Libby, Montana. August 5, 1928. Wm. L. Jellison. In the collection of the author.

A specimen from Mt. Ranier, Wash., agrees except the median callus is smaller and diamond shaped, no spot above, the eyes have a faint short stripe, the antennae, legs and body a little darker, lateral orange of the 2nd abdominal segment more pronounced, and a short "stump-vein" occurs on both wings. If this variety is specifically distinct then it seems likely that other forms within the variations included by Osten Sacken must evidentually be considered, but structural and tinctorial intergrades prevent such treatment at present.

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NOTES ON THE INTRODUCTION OF *DIPRION* PARASITES TO CANADA.

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Preliminary study of the outbreak of the European spruce sawfly (*Diprion polytomum* Htg.) in the Gaspe Peninsula, undertaken in 1931 by the Division of Forest Insects, showed that the extent of the infestation was such that the sawfly could not be economically controlled by chemical or mechanical means. It was found, also, that the sawfly was not attacked by parasites.

Arrangements were, therefore, made by the Dominion Entomologist, with the Farnham House laboratory in England, for investigation of the possibilities of the collection of parasites in Europe, for introduction to Canada. Plans were made for the transference of *Monodontomerus dentipes* Boh., a European parasite already established in Canada on *Diprion simile* Htg., at Oakville, Ont. An enquiry into the possibilities of collection of *Diprion* parasites in the Orient was also made.

The work in Europe, during 1932, included a survey to locate areas where *Diprion polytomum* might be found in numbers large enough for profitable collection. Points were located in Saxony and Bohemia where small collections of *Diprion polytomum* were made. It should be pointed out that, although this sawfly occurs more or less generally over Europe, its collection in large quantities is difficult. It would seem that the control exerted by its natural enemies is such that infestations seldom, if ever, become injurious.

In 1933, while the main effort, as in the preceding year, was to secure parasitized *Diprion polytomum*, outbreaks of other species of *Diprion* were also sought. The object in collection of allied species is chiefly that of securing, in quantity, those parasites which also attack *Diprion polytomum*. Collections of *Diprion polytomum* and *Diprion virens* Kl., and a mixed collection of *Diprion*

frutetorum, D. sertifer Geoff., and *D. virens,* were obtained from Bohemia.

In 1934 the amount of *Diprion polytomum* collected was nearly twice that of the previous year. Also, because of the greatly intensified scouting operations directed toward locating allied species with suitable parasitism, *Diprion frutetorum* was collected in Bohemia, *Diprion pini* L. in Bavaria, and over four million cocoons of *Diprion sertifer* in Bohemia and Hungary.

The plans for collection of material in 1935 did not differ much from those of the previous year. However, two new departures were to collect material in Sweden, and to collect eggs of *Diprion sertifer* as a source of egg parasites. *Diprion polytomum* was collected in Bohemia, and cocoons of *Diprion sertifer* were collected in Bohemia, Hungary and Sweden. The eggs were collected in Bohemia and Sweden.

The following table summarizes the importations of parasitized material to date.

Species	Year of Collection	Country of Origin	Stage of Material	Amount	Total
D. polytomum	1932	Germany	Cocoon	202	
	1932	C.S.R.	"	2930	
	1933	"	"	7653	
	1934	"	"	13558	
	1935	"	"	13427	
					37770
D. sertifer	1934	Austria	Cocoon	16	
	1934	C.S.R.	"	1394000	
	1934	Hungary	"	3009000	
	1935	C.S.R.	"	58750	
	1935	Hungary	"	1019000	
	1935	Sweden	"	636000	
	1935	Sweden (?)	"	3000	
					6119766
D. frutetorum *D. sertifer* *D. virens*	1933	C.S.R.	Cocoon	1550	
					1550
D. virens	1933	C.S.R.	Cocoon	851	
					851
D. frutetorum	1934	C.S.R.	Cocoon	492	
					492
D. pini	1934	Germany	Cocoon	831	
					831
D. sertifer	1935	C.S.R.	Eggs	239000	
	1935	Sweden	"	151000	
					390000

In addition to the above material, 145 cocoons of *Diprion polytomum* which had been submitted to *Eutelus,* 372 laboratory propagated *Microcryptus,* and 26 tachinid puparia were received from Europe.

Apart from these importations, the only other sources of parasites were 14,032 cocoons of *Diprion simile* from Oakville, Ont., and 148 cocoons of *Lygaeonematus erichsoni* Htg., from Fernie, B. C.

The transportation of the European material was effected by the use of air transport from the field to England. The material was repacked at Farnham and shipped in bond to Canada by express in the vegetable chill rooms of the vessels. It was then carried by rail from the port of entry, arriving in Belleville usually about twelve days after leaving Central Europe.

REARING OF THE PARASITES

In 1933, with the amount of parasitized material available comparatively small, rearing was carried out by placing cocoons in small vials, which were plugged with cotton wool. Some material was also placed in bulk in emergence boxes. This latter method has since fallen into disuse, as some of the parasites are negatively phototrophic and, therefore, not readily trapped. The "vial method" of rearing appears to be the ideal method in most respects, for this sort of work, as the adult on emergence is confined in such a way that it may be examined closely without disturbance; the cocoons contents are available if a question of hyperparasitism arises; the danger of escape of injurious species and secondary parasites is reduced; re-parasitim is not possible; and an absolute record of emergence, parasitism, etc., may be kept if desired.

In the second year of the work, although the individual vial method was used for all *D. polytomum* and small lots of other species, and for 370,000 cocoons of *D. sertifer,* further use of the method was abandoned when it became apparent that we would have to handle an amount of material greatly in excess of that which was originally expected. Bulk rearing, therefore, had to be resorted to, which entailed specific quarantine conditions. For the bulk rearing a room was specially prepared and in this was a cage, 10' x 7' x 6½' high, constructed of cotton sheeting, all seams machine sewn, with one end facing the light. The entrance was through a zipper opening. To prevent escape of insects, two vestibules to this cage were also constructed, one at right angles to the other. The entrances of these were also closed by a zipper. The cocoons were placed out on trays, 2' x 2', having a screened bottom, about 30,000 cocoons to a tray.

In 1935, five more similar cages were constructed, so that the cocoons might be divided into smaller lots and thus facilitate handling. The vial method is still used, however, for sample lots and for material where exact data are required.

The emerging parasites were collected into glass topped boxes or other small movable cages, the species being separated as well as was possible at the time. These cages were then removed and the parasites were either stored or immediately prepared for shipment to the field. As the parasites were removed from these smaller cages, the final determination and segregation was made. In those species where it was not possible to separate the sexes by quick inspection, this was done. In all species, when the numbers were not too large, each individual was sexed, but in cases of large daily emergence, this was impossible, so samples were taken several times during the day and an estimate of the total numbers of each sex in the day's emergence was made.

To handle egg parasites, the needles in which the eggs were laid, were selected from the twigs and placed in tight-fitting petri dishes. These dishes were provided with blotting paper, which was moistened when necessary. The parasites were collected by removing the cover of the dish and quickly drawing them up into a fine, glass tube. The species were then separated and sexed under the microscope.

Nearly all the species were shipped from the laboratory in iced containers, which, through the co-operation of the express companies, received special attention during transit. Immediately before packing, the parasites were transferred to metal cans of about pint size, which were screen-sided and were either provided inside with a removable rack and moistened cotton, or with moistened excelsior. The use of excelsior as a packing was found to be very satisfactory, as it provided material to which the insects might cling, in this way crowding was prevented, which was an important consideration in the transportation of many of the species. The smaller parasites, such as the chalcids, were usually shipped in glass vials with a cork stopper.

THE LABORATORY PROPAGATION OF DIPRION PARASITES

Because of the quarantine conditions necessary, the laboratory propagation of many of the *Diprion* parasites has purposely been left in abeyance. However, some investigation in the propagation of the chalcid, *Microplectron fuscipennis*, has been undertaken because it may be reared on the killed host.

The technique which has been developed is a simple one, so that unskilled labour, with a small amount of supervision, may carry out the routine work successfully. A mated female is introduced into a small shell vial containing two cocoons, the larvae in which have been killed by immersion in water at 140°F. for 3½ minutes. The vials are plugged with cotton wool and then placed in an incubator at 80°F. The eggs are soon laid and in twelve days time the pupal stage has been reached. At this point a sample is taken of the batch and the remainder placed in cold storage. Three days later the adult parasites have emerged from the sample cocoons, and the number emerging is used in arriving at the probable number in the batch. These same adults are used as stock for the next generation.

The material from storage is shipped to the field in small, flat cages provided with moist moss, the cocoons being so placed that a layer of them is against the screen on either side, with the moss forming a layer in the middle. The mesh of the screen is large enough to allow the parasites to escape and strong enough to protect the cocoons from rodents. These cages are shipped by mail, and a few days after having reached the field, the parasites emerge. In 1934, 34,500 were propagated, and during 1935 approximately 2,230,000 were propagated and shipped to various points. An experimental lot of over one thousand *Coelopisthia nematicida*, a native parasite, was propagated by much the same technique.

The following table gives the species and numbers of parasites shipped from the laboratory to date:

COCOON PARASITES	1933	1934	1935
Microcryptus basizonius Grav.	379	63021	64458
Monodontomerus dentipes Boh.	13731	1708	3105
Eutelus subfumatus Ratz.	446	1153	966
Microplectron fuscipennis Zett.		888859	2238014
Coelopisthia nematicida Pack.		1110	
LARVAL PARASITES			
Mesoleius multicolor Grav.	108		28
Torocampus eques Htg.			330
Exenterus spp.	142	2282	186658
Holocremnus ratzeburgi Tschek.	132	127	521
Lophyroplectus luteator Thnb.			11937
Sturmia inconspicua Mg.		634	1659
EGG PARASITES			
Achrysocharella ruforum Krausse			5439
Tetracampe diprioni Ferriere			2106
TOTAL	14938	958894	2515521

The above parasites were all liberated against *Diprion polytomum*, with the exception of 46 *Exenterus*, 4,644 *Microplectron* and 135 *Microcryptus*, which were liberated against *Diprion frutetorum* in 1935, and 2,397 *Monodontomerus* which were liberated against *Diprion simile* at Montreal in 1935.

The bulk of the cocoons imported are at present in storage. After the taking of two season's emergence of some of the material, a large number of parasites still remain not fully developed. It may be another year or two before emergence is completed.

FIELD INVESTIGATIONS

The major part of the field investigations in connection with introduced parasites of *Diprion* is being carried on at the Parke Forest Reserve, in Kamouraska County, Que. When this point was selected in 1934 it was near the known western limits of the infestation. During 1935, *Diprion polytomum* was found many miles west and south of the Parke Reserve, but this locality still appears to be the most westerly point of the population occurring in epidemic proportions. The Parke Reserve is ideally located for parasite studies and liberations, because the infestation is more or less recent, and occurs in a mixed stand, approximately sixty-five years old. The parasite establishment in a stand of this type should provide an interesting contrast with that in older infestations in large mature stands, such as are numerous in Gaspe. Good railway service and the proximity of the infestation to the railway station also add to the value of the Parke Reserve as a study centre.

While most of the parasite studies were conducted at the Parke Reserve, liberations were made at other points as well. Areas for parasite liberations were not selected entirely at random, but it has been impossible to follow a definite plan because the distribution of the host insect had not been determined when thought was first directed towards biological control of *Diprion polytomum*. Such plans as could be devised called for surveys to locate the western boundaries of the host distribution and parasite liberations were to be made at strategic points along this boundary, thus enabling the parasite to keep up with the supposed westerly migration of the host sawfly. Of course, the eastern areas already heavily

infested were not neglected, and officers of the Entomological Branch, with the co-operation of the Quebec Government and several of the Quebec lumber companies, liberated approximately 14,000 parasites in 1933, 960,000 in 1934 and 2,500,000 in 1935. Liberation points were usually widely separated because (1) all of the extensive infested area could not be covered and (2) it was felt that future recoveries of the parasite would be more significant in showing their ability to spread. Parasite liberations were centred about two points in New Brunswick, eighteen points in Quebec, south of the St. Lawrence River, and several points in Quebec, north of the St. Lawrence.

The great majority of the parasites received at the Parke Reserve were liberated, but species of larval parasites which arrived in small lots were placed in a "conservation cage." This cage was constructed of a wooden frame covered with wire screening and it enclosed several small spruce trees, which were artificially infested with sawfly larvae. The size of the cage was 18' x 12' x 12', and the roof was removed each fall, thus furnishing the hibernating *Diprion* cocoons protection of the snow. These cocoons were removed each spring, and placed in boxes for emergence records. This work was supplemented with rearings of individual species in smaller cages which were especially constructed according to the particular requirements of the parasite involved.

Cocoon parasites were placed in cages which were implanted over various types of naturally infested ground cover; these experiments give some indication as to the ability or willingness of the parasites to search in the moss or debris for cocoons.

It is difficult to obtain significant data on parasite recoveries due to the habit of *Diprion polytomum* spending 1-5 years in diapause. Consequently, it was found necessary to obtain cocoon samples of the current season's origin, in addition to taking samples from the moss. The former samples were obtained by erecting a large mat, and a series of 2' x 2' "tables" under infested trees. The sixth stage *Diprion* larvae were removed from these daily, and placed in containers for spinning. Cocoon collections from the moss and debris were made at uniform intervals radiating from the liberation point. While the parasites have not as yet been recovered in large numbers, it is really significant that some, at least, are able to establish themselves in Canada.

It is too early to evaluate the *Diprion* parasites in their proper order, but three species are worthy of mention here. Two species of cocoon parasites, *Microplectron fuscipennis* Zett., *Microcryptus basizonius* Grave., and one larval parasite, *Exenterus marginatorius*, have already been recovered. Brief notes on their biology are given below.

Microplectron fuscipennis Zett.—This chalcid parasite was recovered from European *Diprion sertifer* and *Diprion polytomum*. Under laboratory conditions it multiplies readily on *Diprion polytomum* and as many as 215 eggs have been laid by one female. Some of these eggs, we have found, are ingested by host larvae. It is interesting to note that the ultimate stage of the *Diprion polytomum* larva is not adapted for feeding, and that the ingested parasite eggs lodge in the crop of the parasite host. When eggs are artificially placed in the host cocoons, it is possible for the host larva to ingest as many as 90 eggs, but when parsitized naturally, the

larva appears to be partially paralyzed, and the loss of eggs is only of slight importance. The eggs are deposited loosely inside the host cocoon, and each female deposits its complement of eggs in a small number of cocoons. In the laboratory *Microplectron* has been successfully reared on *Diprion sertifer, Diprion polytomum, Diprion frutetorum,* and *Diprion simile.* At the Parke Reserve hibernation of reared material occurs in the pupal, prepupal, and late larval stages. Adults start emerging about the 20th of June. From oviposition to adult emergence requires about a month and three generations were produced during the summer of 1935, in cages, though in the field there must be some overlapping of generations. Both mated and unmated females oviposit. The progeny of mated females are largely females with a small percentage of males. The progeny of unmated females are males.

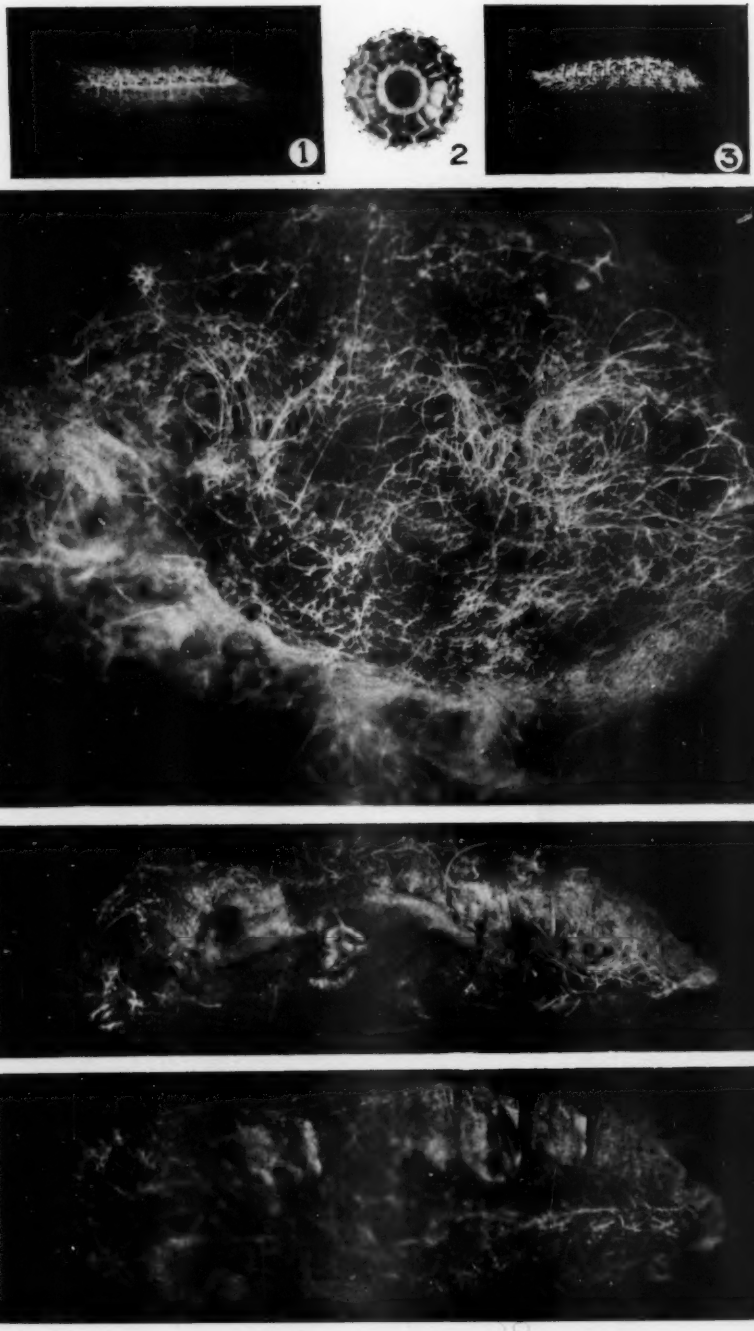
Microcryptus basizonius Grav. is an ichneumon parasite, which, in Europe, has been reared from several species of *Diprion.* It readily attacks *Diprion polytomum* in Canada. Unlike *Microplectron, Microcryptus* is a thorough searcher and is more capable of locating host cocoons in the moss and debris. The eggs are laid singly in the cocoons, and some are lost by the host's habit of endeavouring to destroy all foreign bodies which enter its cocoon. At the Parke Reserve the incubation period averaged about four days. The larva moults four times and the larval period occupies twelve to thirteen days.

Three successive generations have been reared during the summer, though some of the first and second generation pupae remain in diapause until the following season. Hibernation occurs in the pupal and possibly in the late larval stages and the adults of reared material start to emerge about the middle of June.

Exenterus marginatorius F.—This is one of the most promising of *Diprion* parasites. It attacks Canadian *Diprion polytomum* and at the Parke Reserve adults start to emerge during the latter part of June. The adults are long lived, some adults having lived in cages for at least six weeks. An average of 67 eggs was deposited by a lot of seven adults in a cage. The eggs are laid externally on fifth stage *Diprion* larvae. Third and fourth stages are also attacked in cages, but in such cases the parasite eggs hatch prematurely, and the young larvae cannot survive. Normally, the egg hatches in the host cocoon, and the incubation period averages 14.5 days during the month of September. Occasionally a larva is parasitized several times, but only one is able to reach maturity. Oviposition to adult emergence covers a period of four to five weeks. Unmated females produce males and the progeny of mated females are both males and females. One and a partial second generation occur at the Park Reserve.

It is much too soon to make predictions as to the result of the work, but it is hoped that the introduced parasites will prove to be a real factor in the control of the spruce sawfly.

Mailed Saturday, August 1st, 1936.



Immature Stages of Calephelis Borealis